WHAT IS CLAIMED IS:

1. A self-assembly method for depositing nanostructure-containing materials, the method comprising:

forming a nanostructure-containing material;

chemically functionalizing the nanostructure-containing material;

dispersing the functionalized nanostructure-containing material in a liquid medium to form a suspension;

bringing at least a portion of a substrate having a surface that can attract the functionalized nanostructure-containing material into contact with the suspension; and

separating the substrate from the suspension, wherein the nanostructure-containing material adheres to the portion of the substrate when separated from the suspension.

2. The method of claim 1, comprising:

forming hydrophilic and hydrophobic regions on the surface of the substrate before bringing the substrate into contact with the suspension, wherein the functionalized nanostructure-containing material is hydrophilic and adheres to the hydrophilic region of the substrate when separated from the suspension.

3. The method of claim 2, wherein forming hydrophilic and hydrophobic regions comprises:

forming on a surface of the substrate a self-assembled monolayer of organosilanes having a hydrophobic end-group termination; and

exposing a portion of the self-assembled monolayer to ultraviolet (UV) light in an oxygen environment; wherein the exposed portion of the self-assembled monolayer forms the hydrophilic region of the substrate and the remaining portion of the self-assembled monolayer forms the hydrophobic region of the substrate.

4. The method of claim 2, wherein forming hydrophilic and hydrophobic regions comprises:

depositing hydrophobic photoresist on the surface of the substrate;

exposing a portion of the photoresist to ultraviolet (UV) light; and

removing a portion of the photoresist to expose the hydrophilic region of the substrate, wherein the remaining photoresist forms the hydrophobic region of the substrate.

5. The method of claim 4, comprising:

applying a solvent to the substrate to remove the hydrophobic photoresist after separating the substrate from the suspension, wherein the nanostructure-containing material remains adhered to the substrate after applying the solvent.

6. The method of claim 5, comprising:

annealing the substrate prior to removing the hydrophobic photoresist.

7. The method of claim 2, wherein when the substrate comprises glass, the method comprises:

functionalizing a portion of the surface of the glass substrate corresponding to the hydrophilic region of the substrate with organosilanes having an anime end-group termination.

8. The method of claim 1, comprising:

annealing the substrate after separation from the suspension.

9. The method of claim 1, comprising:

removing excess nanostructure-containing material from the substrate after separation from the suspension.

10. The method of claim 1, comprising:

cleaning the substrate prior to bringing the portion into contact with the suspension.

11. The method of claim 10, wherein when the substrate comprises glass, cleaning the substrate comprises at least one of:

placing the substrate into a sonication bath with a solvent;

subjecting the substrate to a mixture of sulfuric acid and hydrogen peroxide; and

exposing the substrate to ultraviolet (UV) light in an oxygen environment.

12. The method of claim 1, wherein bringing the substrate into contact with the suspension comprises:

immersing the substrate in the nanostructure-containing suspension.

13. The method of claim 12, wherein separating the substrate from the suspension comprises at least one of:

withdrawing the immersed substrate from the suspension; and

evaporating the suspension while the substrate is immersed.

14. The method of claim 1, wherein bringing the substrate into contact with the suspension comprises:

arranging the suspension on a portion of the surface of the substrate; and

moving the suspension across the surface of the substrate, wherein the nanostructure-containing material dispersed in the suspension adheres to the surface that can attract the functionalized material.

15. The method of claim 1, wherein bringing the substrate into contact with the suspension comprises at least one of spin-coating and spraying the nanostructure-containing suspension onto the substrate.

16. The method of claim 1, wherein the liquid medium comprises water to form an aqueous nanostructure-containing suspension.

17. The method of claim 1, wherein a concentration of material included in the suspension is between about .0001 to 1 gram of nanostructure-containing material per liter of liquid medium.

18. The method of claim 1, wherein the nanostructure-containing material comprises at least one of single-walled carbon nanotubes, multi-walled carbon nanotubes, silicon, silicon oxide, germanium, germanium oxide, carbon nitrides, boron, boron nitride, dichalcogenide, silver, gold, iron, titanium oxide, gallium oxide, indium phosphide, and magnetic particles including at least one Fe, Co, and Ni enclosed within nanostructures.

19. The method of claim 1, wherein chemically functionalizing the nanostructure-containing material comprises:

partially oxidizing the nanostructure-containing material by reaction with an acid.

20. The method of claim 1, wherein the substrate comprises at least one of silicon, glass, indium-tin-oxide (ITO) coated glass, a metal, metal-coated glass, a plastic, and a ceramic.

21. The method of claim 1, wherein the nanostructure-containing material adhered to the substrate is substantially aligned in one direction.

22. A method of fabricating a patterned carbon nanotube field emission cathode by self-assembly, the method comprising:

forming a material comprising carbon nanotubes;

chemically functionalizing the carbon nanotubes;

dispersing the material comprising the functionalized carbon nanotubes in a liquid medium to form a suspension;

forming hydrophilic and hydrophobic regions on a surface of a substrate that can attract the functionalized carbon-nanotubes;

bringing at least a portion of the substrate into contact with the suspension; and

separating the substrate from the suspension, wherein the carbon nanotubes adhere to the hydrophilic region of the substrate when separated from the suspension.

23. The method of claim 22, comprising:

annealing the substrate after separation from the suspension; and

removing excess carbon nanotubes from the substrate after separation from the suspension.

24. The method of claim 22, wherein chemically functionalizing the carbon nanotubes comprises:

partially oxidizing the carbon nanotubes by reaction with an acid.

25. A field emission cathode produced in accordance with the method of claim 1.

26. A field emission cathode produced in accordance with the method of claim 22.

27. An apparatus for depositing nanostructure-containing materials on a substrate, the apparatus comprising:

means for forming a nanostructure-containing material;

means for chemically functionalizing the nanostructure-containing material;

means for dispersing the functionalized nanostructure-containing material in a liquid medium to form a suspension;

means for bringing at least a portion of the substrate having a surface that can attract the functionalized nanostructure-containing material into contact with the suspension; and

means for separating the substrate from the suspension, wherein the nanostructure-containing material adheres to the portion of the substrate when separated from the suspension.

28. The apparatus of claim 27, comprising:

means for forming hydrophilic and hydrophobic regions on the surface of the substrate before bringing the substrate into contact with the suspension, wherein the functionalized nanostructure-containing material is hydrophilic and adheres to the hydrophilic region of the substrate when separated from the suspension.